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INVESTIGATIONS ON WIREWORM CONTROL WITH ORGANIC INSECTICIDES IN NEW JERSEY*[1]

BAILEY B. PEPPER, JOHN P. REED[2] AND JOHN C. CAMPBELL[3],

New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, N. J.

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Wireworms have long been a serious limiting factor in the production of high quality potatoes and other crops. Prior to World War II control measures were limited to various cultural practices, many of which could not be employed on a practical basis, and soil fumigants, which were too costly for practical field use. During and immediately following the war there appeared several synthetic organic compounds that had exceedingly high insecticidal action and long residual action against many species of insects. On the basis of available information on these compounds it was believed that some of them might have value as soil insecticides to control wireworms. Accordingly, in 1945 experiments were initiated to determine their value as controls for these important pests.

The studies by Pepper *et al* (1946 and 1947), Greenwood (1947) and Post *et al* (1947) showed that benzene hexachloride in relatively small quantities per acre gave excellent control of wireworms attacking

potatoes. The same treatments as reported by Pepper *et al* (1947) were applied to market garden soils which were planted to cabbage, cauliflower, celery and onions with comparable wireworm control. These studies were continued in 1947 and 1948 by the writers. Several additional chemical compounds have been tested since 1946. The purpose of this paper, therefore, is to summarize our investigations to date.

Field Experiments in 1947

The data from tests made in 1945 and 1946 showed a high degree of control from the use of technical benzene hexachloride at dosages ranging from 0.5 to 10 pounds of gamma isomer per acre. In the same tests DDT and its analogs used at much higher rates gave poor wireworm control generally. It was decided, therefore, to place emphasis on benzene hexachloride dosage rates, methods of applications, time of applications, comparison of technical with purified grades and to test the value of parathion, chlordan, chorinated camphene and ethylene dibromide. In the case of benzene hexachloride, tests were made on several different farms for the purpose of determining the effect of soil type on toxicity to wireworms.

Dosage Experiments with Technical BHC. — A series of plots were set up to determine the minimum dosage of benzene hexachloride required to control wireworms. Each treatment was replicated four times on plots 50 feet by 50 feet square. Samples of tubers for wireworm counts and yield records were taken from the centers of the plots on 1/100 of an acre area per replicate. The technical material was diluted with talc in proportions to give the desired rate of the gamma isomer in 200 pounds of the mixture applied per acre. All materials were mixed in a power driven dust mixer. A wheelbarrow type fertilizer and lime spreader was used to distribute the powdered material after the land was plowed in the spring. After application the plots were thoroughly disked. This experiment was repeated on three different farms. The results are presented in table 1.

As pointed out in previous reports, the yields have been significantly higher in the plots treated with benzene hexachloride than in those receiving other treatments. The data in table 1 show that 0.5 lb. of gamma isomer is about the minimum effective dosage. Greenwood (1947) and

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*Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey, Department of Entomology.

[1]Mr. C. A. Wilson assisted with these studies in 1947.

[2]Entomologist, Research Associate in Entomology.

[3]Assistant Research Specialist, Plant Pathology.

TABLE 1.—*Dosage rates of technical benzene hexachloride*—1947.

Gamma Isomer Dosage per Acre	Yield per Acre	Number Tubers		Per cent Tubers Infested
		Examined	Infested	
	Bushels			
Tests at Hightstown, N. J., Katahdin variety				
.13 lbs.	557.7	3764	79	2.09
.26 lbs.	511.0	3483	50	1.44
.52 lbs.	530.2	3775	38	1.01
1.04 lbs.	577.7	4090	11	0.27
2.08 lbs.	550.6	3543	2	0.06
Check	430.0	3039	290	9.54
Tests at Freehold, N. J., Katahdin variety				
.13 lbs.	530.4	2633	67	2.54
.26 lbs.	503.6	2204	41	1.86
.52 lbs.	531.3	2490	5	0.20
1.04 lbs.	555.1	2683	5	0.19
2.08 lbs.	547.4	2635	3	0.11
Check	466.4	2302	168	7.30
Tests at Mount Holly, N. J.,* Cobbler variety				
23 lbs.	413.1	1652	234	14.16
.42 lbs.	449.2	1768	165	9.33
.90 lbs.	448.8	1770	39	2.20
Check	413.1	1836	370	20.15

*Standard lime spreader used.

Post *et al* (1947) obtained effective control with approximately 0.2 pound gamma isomer per acre.

Experiment on Method of Application. — In our 1946 experiments the results showed that hand and power driven dusters gave poor distribution of the material and the question arose as to the best method of applying the insecticides. An experiment was set up for the purpose of determining the best method of distributing the materials and also to determine whether the toxicant could be mixed with fertilizer and applied broadcast. The procedure followed in this test was essentially the same as that followed in the dosage test previously described. Each treatment was replicated four times on plots 50 feet by 50 feet square. The same dosage level was used on all plots, namely 0.5 pounds of gamma isomer per acre derived from the technical grade material. The dry materials were mixed in proportions to give the desired level of the toxicant in 200 pounds of the mixture. Talc was used as the diluent except in the case of the fertilizer plots. A 5-10-5 fertilizer was used in this case and the benzene hexachloride was added and thoroughly mixed with a shovel on a concrete floor. The regular dust mixture was mixed in a power dust mixer. In the spray plot the technical grade

benzene hexachloride was suspended in water in proportions to give 0.5 pound of the toxicant in 100 gallons of water. The spray was applied at the rate of 100 gallons per acre with a power sprayer using an orchard type spray gun.

All pieces of application equipment were calibrated to give the desired dosage. The results of this experiment are presented in table 2.

TABLE 2.—*Experiment on methods of applying technical benzene hexachloride at level of* 0.5 *pounds of gamma isomer per acre.*

Treatment	Yield per Acre	Number Tubers Examined	Number Tubers Infested	Per cent Tubers Infested
	Bushels			
Tests at Hightstown, N. J., Katahdin variety				
Hand duster	564.3	3856	104	2.70
Hand distributor	590.2	3940	34	0.86
Hand distributor—fertilizer	544.2	3845	68	1.77
Grain drill	594.2	4030	18	0.45
Spray	540.0	3769	10	0.27
Hand distributor—plowed under	544.2	3811	258	6.77
Check—no treatment	532.7	3643	370	10.16
Tests at Freehold, N. J., Cobbler variety				
Hand duster	476.0	2136	52	2.43
Hand distributor	456.0	2219	11	0.49
Hand distributor—fertilizer	486.2	2090	29	1.39
Grain drill	442.4	2432	13	0.53
Spray	435.2	1954	19	0.97
Hand distributor—plowed under	446.3	2071	48	2.32
Check—no treatment	456.4	2102	168	7.99

As noted in table 2 the number of injured tubers was much higher where the benzene hexachloride was applied by a hand duster or where it was plowed under. Also there was some increase in the number of injured tubers when the toxicant was mixed with fertilizer.

In supplementary tests it was found that when benzene hexachloride was applied in spray form on land covered with debris and plowed under or harrowed in the results were poor. Other tests were conducted where the dry material was applied over a cover crop of grain and poor control resulted. In these cases apparently the insecticides generally stick to the cover crop material or debris on the surface and do not become thoroughly incorporated in the soil.

Observations indicate that when dust applications are made with a power duster the insecticide does not necessarily fall where it is directed and an uneven distribution results.

Experiments on Time of Application. — After observing the amazing results from tests in 1946 the question arose as to the best time

to apply benzene hexachloride for effective control of wireworms. It would seem logical for a potato grower to observe carefully the location of wireworm infestations as the potato crop is harvested and to treat only the infested area immediately thereafter provided the treatment would be effective on the next year's crop. In order to ascertain this information an experiment was devised wherein plots were treated after the potatoes were harvested in the fall of 1946 and other plots received a similar dosage of the same formulation in April 1947. The same plot arrangements were employed as described in the above-mentioned experiments. After the plots were staked out and the fall treatments applied the soil was thoroughly disked and seeded to cover crop. In the spring, the field was plowed and the spring applications were made to the proper plots after which the land was disked and planted to potatoes. In addition to the problem on time of application the question arose regarding the effect of applications on the foliage of growing plants in connection with tuber infestations. Since benzene hexachloride was used in spray and dust experiments for the control of foliage feeding insects, tuber samples from these plots were compared with those from untreated plots and those receiving calcium arsenate for wireworm injury. The data from these tests are presented in table 3.

TABLE 3.—*The effect of time and method of application of technical benzene hexachloride on wireworm control.*

Treatment	Yield per Acre	Number Tubers		Per cent Tubers Infested
		Examined	Infested	
	Bushels			
Sept. 1946—0.5 lbs. gamma isomer	421.7	636	4	0.63
Sept. 1946—1.0 lbs. gamma isomer	432.0	711	6	0.84
April 1947—0.5 lbs. gamma isomer	436.5	654	5	0.76
April 1947—1.0 lbs. gamma isomer	442	725	4	0.55
Check	386	692	254	36.71
Spray—0.25 lbs. gamma isomer*	—	225	5	2.22
Dust —0.25 lbs. gamma isomer	—	225	6	2.67
Check	—	225	80	35.56

*8 applications of spray and dust made on these plots beginning in early June and continued at weekly intervals for 8 weeks, giving a total of approximately 2 pounds of gamma isomer per acre for the season.

It is noted in table 3 that there is no apparent difference between fall applications and spring applications of benzene hexachloride to the soil. Even the spray and dust applications to the growing plants gave

a marked reduction in tuber injury but were not so effective as the soil treatments.

Experiment on Effectiveness of Different Insecticides. — An experiment was conducted to determine the value of deodorized benzene hexachoride, toxaphene, parathion, chlordan and ethylene dibromide in comparison with the technical benzene hexachloride. Unfortunately, it was not possible to use all of the materials in the same field. Some of the materials were not available when the grower planted the field where it was originally planned to make the test. The ethylene dibromide treatments were applied in September, 1946, on acre plots duplicated in two separate fields. The other materials were tested on 50x50 feet square plots replicated four times. Untreated checks and with technical benzene hexachloride were located in each field for comparison.

The data from these experiments are set forth in table 4.

TABLE 4.—*A comparison of different insecticides applied to the soil for wireworm control*—1947.

Treatment (Figures represent active ingredients per acre)	Yield per Acre	Number Tubers		Per cent Tubers Injured
		Examined	Injured	
	Bushels			
Deodorized BHC 0.5 lbs. gamma isomer	483.2	2153	16	0.74
Deodorized BHC 1.0 lbs. gamma isomer	492.3	2084	8	0.38
Technical BHC 0.5 lbs. gamma isomer	497.3	2360	34	1.44
Chlorinated camphene 8 lbs.	449.7	2149	90	4.19
Parathion 5 lbs.	467.5	2211	110	4.97
Check	460.4	2302	168	7.30
Chlordan 4 lbs.	490.8	2079	393	18.90
Chlordan 8 lbs.	490.8	1801	149	8.27
Technical BHC 0.5 lbs. gamma isomer	537.2	2136	17	0.80
Check	369.2	1665	345	20.72
Ethylene dibromide 2 gallons	357.5	685	26	3.79
Technical BHC 0.5 gamma isomer	421.7	625	5	0.80
Check	394.2	729	112	15.36
Ethylene dibromide 2 gallons	418.3	885	11	1.24
Ethylene dibromide 2.3 gallons—sprayed*	428.2	681	48	7.05
Technical BHC 0.5 lbs. gamma isomer	438.3	842	4	0.47
Check	386.7	1029	271	26.34

*The ethylene dibromide-naphtha mixture was emulsified with "Tween 80" and sprayed on the surface of the soil with a power driven potato sprayer, immediately after which the soil was thoroughly disked.

With the exception of the ethylene dibromide which is a liquid, all the other materials were in dust form and were diluted with talc so that by using an application rate of 200 pounds per acre the required dosages of toxicant were obtained. The ethylene dibromide used was a mixture of 1 part ethylene dibromide to 9 parts of naphtha by volume supplied by the Dow Chemical Company. Except for the spray plot the other two plots were applied with an injection apparatus loaned by the Dow Chemical Company.

The deodorized benzene hexachloride is reported to be a purified material containing approximately 90 per cent gamma isomer. A supply was received from the California Spray Chemical Corporation and the Niagara Division of the Food Machinery Corporation under the trade names of "Isotox" and "Hi-Gam" respectively.

The chlordan used was a 40 per cent concentrate supplied by Sherwin-Williams Company.

The chlorinated camphene was a 50 per cent concentrate supplied by the American Cyanamid Company. This company also supplied the parathion as a 15 per cent wettable powder.

The data in table 4 show that the two grades of benzene hexachloride and the ethylene dibromide were the only materials that gave a reasonably high degree of control. However, the 8 pounds of chlordan reduced the injury by about 60 per cent. Parathion and chlorinated camphene were only slightly effective at the dosages used.

These same materials were used on a heavily infested market garden soil on which cabbage and cauliflower were planted. Here the ethylene dibromide was applied in the bottom of the plow furrow as the land was plowed. A can with a spout connection was used to apply the liquid in the furrow bottom at the desired dosage. In this case the wireworm mortality was approximately 100 per cent, using the same dosage as used on potato soil.

D-D mixture was also used on the market garden soil at 10 and 20 gallons per acre with results inferior to those with ethylene dibromide. The cost of the D-D mixture application was 2 to 3 times that of ethylene dibromide and it also required much longer to disappear from the soil.

The parathion, benzene hexachloride, chlorinated camphene and chlordan gave about the same order of control as shown in the potato experiments, table 4.

Field Experiments in 1948

The question of the effects of the different treatments on the flavor and quality of the tubers in the 1947 experiments was confusing and

uncertain and it was decided to place emphasis on this problem in 1948. The experiments were limited to two locations in 1948 and every precaution was exercised to prevent possible contamination from one treatment to another. The sites selected for the tests were fairly level and treatments were made only when the wind was favorable in order to prevent the blowing of the dust materials from one plot to another.

One series of experiments was located at East Freehold and the other at the College Farm, New Brunswick, where the writers had complete control. Plots 25 feet wide by 40 feet long were employed and each treatment was replicated three times. The materials were mixed in a power driven dust mixer in concentrations to give the desired dosage of toxicant when an application rate of 200 pounds of dust per acre was used. All applications were made with the hand-operated fertilizer distributor. At East Freehold the grower followed the regular spray program for foliage insect and disease control. At the College Farm the foliage sprays were limited to three applications of rotenone for insect control, the purpose being to minimize the possibility of interfering with taste and odor of tubers by a regular spray program. Unfortunately, foliage feeding insect damage was severe and the yields at New Brunswick were very low in comparison with the commercial plantings. The wireworm control data in the two experiments were so closely parallel that, for brevity, only the data from the College Farm experiment are presented in table 5. This table gives not only the materials used but also the yields and tuber infestation obtained.

It will be noted from table 5 that the yields were somewhat erratic. This may be accounted for in part by the fact that the growing season was very wet and cultivation was limited by wet soil. As a result some areas were overrun by weeds. Also, soil fertility probably accounts for part of the irregularity.

There is some evidence that certain of the materials tend to suppress yields whereas others tend to increase them. Chlorinated camphene as shown in the 1947 experiments and in table 5 above tends to reduce the yield. On the other hand, it has been noted in nearly every test that benzene hexachloride appears to stimulate yield.

It is interesting to note that parathion at 10 and 20 pounds per acre gave excellent control of wireworms, whereas the 5-pound rate was insufficient both years. It also appears to result in increased yields.

Chlordan has not performed so well in our tests as informal reports from other investigators have indicated. However, 8 and 16 pounds

TABLE 5.—*A comparison of varying dosages of insecticides and different insecticides.*

Treatments—Amount Actual Toxicant per Acre	Yield per Acre	Per cent Tubers Infested
	Bushels	
Deodorized BHC 0.125 lbs. gamma isomer	119.7	3.8
" " 0.250 " " "	118.0	3.9
" " 0.5 " " "	142.1	2.4
" " 1.0 " " "	141.0	0.2
Technical BHC 0.5 " " "	165.2	0.3
Pure gamma BHC 0.25 " " "	134.8	2.1
" " " 0.5 " " "	162.7	0.9
" " " 1.0 " " "	107.8	2.6
Chlordan 2 lbs.	113.3	7.9
" 4 lbs.	111.0	4.8
" 8 lbs.	163.0	1.5
" 16 lbs.	140.0	1.0
Parathion 5 lbs.	118.0	6.1
" 10 lbs.	128.0	0.8
" 20 lbs.	195.0	0.3
Chlorinated camphene 25 lbs.	122.4	3.2
" " 50 lbs.	76.4	0.9
Check	131.9	12.5

The pure gamma isomer has a melting point of 112.6-113.8°C., supplied by General Chemical Company. The identity of other materials in table 5 is given in the 1947 experiments.

per acre gave good control in 1948 in our tests, but the 8-pound rate gave only 60 per cent reduction in infestation in 1947.

Tests in 1947 and 1948 indicate that there is little or no difference in the toxicity between technical, deodorized or pure gamma isomer of benzene hexachloride provided the dosages of gamma isomer are equal.

RELATIONSHIP OF TREATMENT TO QUALITY

Because of the strong musty persistent odor of technical benzene hexachloride it was surmised from the beginning that it might affect the flavor or quality of tubers. As reported in 1946 there was some off-flavor but it was detectable by only a small percentage of individuals. In 1947 conditions were somewhat different. Although samples from our experimental plots did not give a clear-cut picture, potatoes from some commercially-treated fields were severely affected.

All of the quality testing work at this station in 1947 and 1948 was done by Dr. Walter A. Maclinn and associates in the Food Technology Department.

Potatoes from the ethylene dibromide plots appeared to be free from any off-flavor due to the treatments,

In addition to taste tests, bioassays have been run on the same samples using mosquito larvae as the test organism. No toxicity has been noted in any of the samples. Chemical analyses have been made but they are inconclusive. The only chemical treatment that has given satisfactory wireworm control and is absolved from the possibility of imparting off-flavor is ethylene dibromide which should be applied during the fall preceding the potato crop.

The taste tests on sample of tubers grown in 1948 gave results that appear to have some significance. The tests for potato tubers grown in 1948 on soils treated in 1947 are summarized in table 6. The data show that the tubers from the treated plots were comparable with those of the check, indicating that the strong taste of technical benzene hexachloride is greatly reduced or eliminated after being in the soil for a year.

Table 7 summarizes the data obtained from tubers grown in soils that had been treated just prior to planting. Technical benzene hexachloride resulted in definite off flavors in the tubers whereas those grown in plots treated with refined and pure gamma isomer benzene hexachloride were much less offensive. Chlordan gave slightly less off-flavor than benzene hexachloride, whereas the parathion treatments were the least offensive of all, comparing quite well with the check.

TABLE 6.—*Summary of taste tests on tubers grown in* 1948 *on soils treated in* 1947.

Material	Dosage Range Lbs./Acre	No. Times Sampled	Per cent Times Reported as		
			Off	Flat	Pleasing
Technical BHC*	0.13 - 0.52	92	19.5	31.5	50.0
Technical BHC*	1.04 - 2.08	92	20.7	39.1	40.2
Check	-	62	27.4	35.5	37.1

*Dosage expressed as gamma isomer.

GENERAL DISCUSSION AND SUMMARY

The research conducted in New Jersey with the new synthetic organic insecticides has demonstrated that benzene hexachloride, chlordan, parathion and ethylene dibromide are effective in controlling wireworms. The data also show that it requires approximately 0.5 pounds of gamma isomer for effective control where large populations of the insect are present. Smaller dosages may give control under low popu-

TABLE 7.—*Summary of taste tests on tubers grown in* 1948 *on soils treated just prior to planting.*

Material	Dosage Range Lbs./Acre	No. Times Sampled	Per cent Times Reported as		
			Off	Flat	Pleasing
Technical BHC*	0.25 - 0.50	36	69.5	16.6	13.9
Refined BHC*	0.125 - 1.0	118	31.0	22.0	46.0
Pure g.i. BHC*	0.25 - 1.0	29	34.5	44.8	20.7
Chlordan	2 - 16	106	28.3	26.4	45.3
Toxaphene	25 - 50	79	20.3	40.5	38.2
Parathion	5 - 20	33	15.1	33.3	51.5
Check	-	36	11.1	25.0	63.9

*Dosage expressed as gamma isomer

lation conditions. DDT, TDE and chlorinated camphene have failed to give adequate control in most cases even at rates of 25 to 50 pounds per acre.

Chlordan at 8 or more pounds per acre has shown promise, but appears to have the same disadvantages as benzene hexachloride from the standpoint of producing off-flavors which in some instances were very objectionable.

Parathion at 10 to 20 pounds per acre resulted in good wireworm control and very little off-flavor was found when tubers from treated areas were compared with tubers from untreated plots, or with those from areas treated with any form of benzene hexachloride or chlordan. The relatively high cost may limit its use, should it be found on further investigation to be safe to use.

At the present time there is no chemical treatment within reasonable cost range that can be safely used on potatoes to control wireworms, except ethylene dibromide. Even with this latter compound there is need for improved methods of applications.

It is possible that some of the insecticides which have been found to result in the least off-flavor may find a place in the potato program by treating wireworm-infested soils a year previous to the planting of potatoes. In order to prove this point, much more research work needs to be conducted.

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CANUS: A NEW POTATO VARIETY ADAPTED TO ALBERTA AND OTHER SECTIONS OF THE DOMINION OF CANADA

F. J. STEVENSON[1]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Md.

AND

G. E. DELONG[2]

Superintendent of Branch Farm, Canada Department of Agriculture, Lacombe, Alberta, Canada

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ORIGIN

The Canus variety of potato, U.S.D.A. Seedling 41914, is not so well adapted as Katahdin, Chippewa, and several others to the potato-growing sections of the United States, but has shown so much promise in tests in Alberta and other sections of the Dominion of Canada that it has been increased and distributed to growers in that country. It is one of the results of cooperative work that has been carried on between the two countries for a number of years.

The variety is a hybrid first grown on the Aroostook Farm, Presque Isle, Maine, in 1921 when Dr. William Stuart was in charge of potato investigations for the United States Department of Agriculture and Dr. C. F. Clark was leader of the potato-breeding work. As part of the work of the National Potato-Breeding Program a relatively large number of seedlings have been sent to Canada by the United States Department of Agriculture, and Canada has reciprocated by sending varieties and species to the United States.

Canus is of hybrid origin and so is the name—"Can" for Canada and "us" for United States.

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[1]Principal Geneticist, Division of Fruit, and Vegetable Crops and Diseases, Beltsville, Md.

[2]Superintendent of Branch Farm, Canada Department of Agriculture.

Canus originated from a cross between Greeley Seedling 9-11 and U.S.D.A. Seedling 25642.

The pedigree follows:

	(	(Sutton's Flourball
	(U.S.D.A. Seedling	(
	(No. 24642	(
Canus,	(	(Aroostook Wonder
U.S.D.A. Seedling	(	
No. 41914	(	(Villaroela
	(Greeley Seedling	(
	(No. 9-11	(
	(	(Selfed

Greeley Seedling No. 9-11 was a selection from a selfed line of the South American variety Villaroela, made by C. F. Clark when he was engaged in potato-breeding work at the Potato Experiment Station, Greeley, Colorado.

Sutton's Flourball was an English variety according to Stuart (3). Aroostook Wonder was identical with the American Giant, and according to Clark and Lombard (1) American Giant is a synonym of White Rose. The Aroostook Wonder is therefore the White Rose.

Description

Plants. — Medium in size and spreading; stems medium-thick and prominently angled; nodes slightly swollen and green; internodes reddish purple; wings straight and green; stipules medium in size, green, and glabrous; leaves medium to long, broad open, and medium green; midribs green and scantily pubescent; primary leaflets ovate, medium in size, three pairs; mean length of blade 61.51±0.58 mm. (2.42 inches), mean width 34.19±0.36 mm. (1.35 inches), index 55.64±0.35; leaflet petioles green; secondary leaflets medium in number, having two positions on midrib, between primary leaflets and at junction of midrib and petiole of primary leaflet; tertiary leaflets none; inflorescence medium-branched and leafy bracts few; peduncles short to medium, green, and scantily pubescent; pedicels medium length, pigmented, medium pubescent.

Flowers. — Calyx lobes long, green, and scantily pubescent; corolla medium in size (29-31mm.), white tips and mauvette; anthers orange yellow; pollen scant and poor quality; styles straight; stigma globose, multi-lobed, and green.

Tubers. — Roundish oblong, somewhat flattened; mean length 84.79±0.83 mm. (3.34 inches); mean width 80.18±0.73 mm. (3.16

inches); mean thickness 57.71±0.58 mm. (2.27 inches); indexes, width to length 94.95±0.90, thickness to width 72.11±0.64, thickness to length 68.51±0.91; skin smooth, creamy white; eyes not numerous, shallow; flesh white; maturity medium-early.

The plant description was made by Robert V. Akeley, Presque Isle, Maine; the tuber measurements and calculations were made at the Plant Industry Station, Beltsville, Maryland; and the leaf index was calculated by dividing the width of each of 100 leaflets by their length, and multiplying the average of these ratios by 100. The leaflets were taken from the fourth leaf from the top of the stem; one leaflet, the distal left lateral, was taken from each leaf. Since the potato leaflet is asymmetrical, the length was determined by taking the average of the measurements from the apex to the base of each respective lobe. This is a modification of the method described by Salaman (2), (see pages 163-170).

Tuber measurements were taken on 85 potatoes grown on Aroostook Farm, Presque Isle, Maine, each weighing approximately 8 ounces (224.05±5.02 gm.). The same measurements were used to calculate the three indexes: width to length, thickness to width, and thickness to length. The index for width to length was calculated by dividing the width of each tuber by its length and multiplying the average of the 85 ratios by 100. The other indexes were calculated by the same methods.

Characteristics

From 1932 to 1936 Canus was tested rather extensively in the United States as part of the National Potato-Breeding Program. Tests were made in Florida, Iowa, Kansas, Louisiana, Maryland, Mississippi.

Table 1.—*Yields of Canus in comparison with three standard varieties at the Dominion Experimental Station, Lacombe, Alberta.*

Year	Canus		Netted Gem		Irish Cobbler		Chippewa	
	Yield per Acre	Marketable	Yield per Acre	Marketable	Yield per Acre	Marketable	Yield per Acre	Marketable
Tested	Bus.	Pct.	Bus.	Pct.	Bus.	Pct.	Bus.	Pct.
1939	264	88	217	64	215	84	235	95
1940	403	95	352	50	318	97	352	90
1941	392	90	366	69	314	82	402	79
1942	463	94	423	78	509	80	466	88
1943	332	96	338	93	240	90	356	97
1944	458	90	385	86	304	77	568	77
1945	565	83	387	73	500	81	519	83
Average	411	91	353	73	343	84	414	87

Michigan, New Jersey, New York, North Carolina, North Dakota, Ohio, Rhode Island, South Dakota, and Virginia. It was promising in a number of these tests but did not seem to be as widely adapted as Katahdin and Chippewa with which it had to compete. Consequently, it was not increased for distribution in the United States. That it was selected in preference to other seedlings in Alberta is not surprising, for frequently a variety may be inferior in one part of the country and superior in another.

In Alberta, Canus is a medium-early variety that produces a high yield of uniform tubers, a high percentage of which are marketable. The vines are medium in height and the stalks are coarse and upright in habit of growth. The leaves are medium in size, rather short and rounded in shape, and of a normal green shade; the tubers are roundish-oblong, somewhat flattened; the eyes are not very numerous and are shallow; the buds are green, tinged with violet; there are only slight depressions at the seed and stem ends; the skin is smooth and creamy white; the flesh is white and has a well-defined starch line; the baking

TABLE 2.—*Yields of Canus in comparison with other varieties of potatoes at various locations throughout Canada.*

Year Tested	Location	Canus		Irish Cobbler		Chippewa	
		Total Yield per Acre	Marketable per Acre	Total Yield per Acre	Marketable per Acre	Total Yield per Acre	Marketable per Acre
		Bus.	Bus.	Bus.	Bus.	Bus.	Bus.
1946	O.A.C., Guelph,	410	393	310	295	337	320
	University of Manitoba	317	285	310	284	286	
1947	O.A.C., Guelph,	307	243	299	256		
	University of Manitoba	638	537	744	576	664	237
1938	Prince George, B.C.	268	211	266	205		511
	Lacombe, Alta.	503	489	613	514		
	Scott, Sask.	475	398	275	165		
	University of Manitoba	630	554	532	464		
	Fort William, Ont.	211	202	178	166		
	O.A.C., Guelph,	317	274	280	232		
	Smithfield, Ont.	266	234	327	193		
		Green Mountain					
	St. Clothilde, P.Q.	725	686	543			
		Green Mountain					
	Bradford, Ont. (muck land).	546	493	498	450	Netted 492	Gem 406

quality is excellent, and it boils dry and mealy. The resistance of the variety to disease has not been definitely established but pathologists report the seed stocks at present as "being free from virus diseases, scab, and blackleg."

The yield data for Canus in comparison with those of Netted Gem, Irish Cobbler, and Chippewa for a period of 7 years at the Dominion Experimental Farm, Lacombe, Alberta, are given in table 1. Canus outyielded Netted Gem and Irish Cobbler, but not Chippewa.

Under irrigation in southern Alberta, Canus has yielded 667 bushels per acre. It finds favor in that area as it is a midseason variety fitting between the Irish Cobbler and Netted Gem seasons.

Canus has done well on heavy clay soils of Manitoba, but in tests in 1946 it did not significantly outyield Irish Cobbler, with which it would have to compete, in any of six commercial areas of that province.

In a number of other tests at various locations in Canada, Canus has shown promise. It has outyielded the standard varieties in nearly all these tests, as can be seen in table 2.

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THE COMPARATIVE LENGTH OF DORMANT PERIODS OF 35 VARIETIES OF POTATOES AT DIFFERENT STORAGE TEMPERATURES

R. C. Wright[1] and T. M. Whiteman[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Md.

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The length of time that different varieties of potatoes will remain dormant in storage is of practical and scientific interest to plant breeders and commercial storage operators alike. The fact that different varieties

[1]Physiologist.
[2]Assistant horticulturist.
[3]Wright, R. C. and Peacock Wm. Influence of storage temperatures on the rest period and dormancy of potatoes. U. S. Dept. of Agr. Technical Bull. No. 424, May, 1934.

vary in the length of their dormant periods at any one temperature was shown in 1934 in the U. S. Department of Agriculture Technical Bulletin 424.[1] In that publication an attempt was made to show separately the rest period and dormant period of the varieties studied. It was stated by way of definition "There is some confusion as to the meaning of the terms dormant period and rest period. In this discussion the term rest period in potato tubers refers to that period immediately following harvest during which they will not sprout even when kept under favorable growing conditions. Under the same conditions at the end of this rest period growth activity evidenced by the production of sprouts becomes apparent. On the other hand, if potatoes are held at a temperature too low for sprout growth they will remain in a dormant condition . . ." The dormant period in that discussion and in the present one is defined as the total period in which potatoes remain without sprouting within given storage conditions irrespective of the rest period. The previous publication, of course, dealt only with varieties grown at that time and some of these are now out of commercial production. Since that time a considerable number of new varieties have been introduced and some of these have already come to be of commercial importance.

The investigation reported herewith was begun in 1945 to study some of these newer varieties as well as certain seedlings under test, along with some old varieties still of importance. These were held at temperatures usually found in ordinary storage and handling operations. This investigation was continued during the normal winter storage seasons of 1945-1946, 1946-1947, and 1947-1948. The 53 varieties studied included five unnamed seedlings. All of these were grown in Aroostook County, Maine, by specialists of the Potato Investigations section of this Bureau. They were grown on a uniform type of soil, thus affording a direct varietal composition without the complicating influences of various growing conditions. Each season the potatoes were harvested approximately the last week in September. They were held a few days in a cool bank storage at about 60°F. until a railroad refrigerator car-lot, including other material, was assembled and sent under standard ventilation to the Beltsville laboratory. Approximately three weeks elapsed between harvest and final storage. On arrival the different varieties were each apportioned into lots of 18 uniform sized tubers and these were stored at constant temperatures of 70°, 60°, 50°, and 40° with a relative humidity of 85 per cent at each temperature. At one-week intervals each lot was examined until more than seventy-five per cent of the tubers showed a definite initiation of sprout growth.

In the following table is given the average number of weeks required by each variety of potatoes to show the initiation of sprouting while held continuously at these temperatures. This period includes the three weeks between harvest and the beginning of controlled storage. Where "+" follows a value in the table it signifies that the lot was still dormant when observations were discontinued for that season.

An examination of the results reveals little difference in dormancy at 70°F. and at 60°, the average difference in time being only about a week. With certain varieties there was a difference of two to three weeks, between lots held at 60° and 50°, whereas in other varieties the difference in sprouting time at these temperatures was greater. The average difference was about six weeks. It should be noted that the Potomac variety which at 60° sprouted at about the same time as many of the other varieties, never sprouted at 50° during the three seasons of the test. The difference in the dormant periods at 50° and at 40° was proportionally greater than between the higher temperatures—amounting to an average of 17 or more weeks. In 40° storage a number of varieties, including the Chippewa, Erie, Irish Cobbler, Katahdin, Pontiac, Potomac, Sebago, Sequoia, and seedling 47258, did not sprout while under test during one or more seasons. Each season the tests at this temperature were run much later than there should be any practical need to store potatoes. Varieties with comparatively short dormant periods at 40° were Calrose, Cayuga, Earlaine, Earlaine 2, Golden, Kasota, Pawnee, Russet Rural, and Rural New Yorker. The Golden had the shortest dormant period at 40°. Sebago, which did not break dormancy at 40° during the tests, ranked with the varieties having shorter dormant periods at the higher storage temperatures; whereas the Mohawk, Russet Burbank, and White Rose showed relatively long dormancy at 70°, 60°, and 50°, and a relatively short period at 40°.

Discussion

Since potatoes from storage at the relatively high temperature range from 50°F. to 60° are more suitable for immediate use because of their lower sugar content than those from lower temperatures, it is of advantage to storage operators to know the varieties that remain dormant for the maximum period of time within this temperature range. Selecting 14 weeks as an arbitrary dividing line between relatively "long-keepers" and "short-keepers" at 50°, we see that the varieties remaining free from sprouting for 14 weeks or longer include Erie, Green Mountain, Irish Cobbler, Katahdin, Kennebec, Mohawk, Pontiac, Potomac, Russet Burbank, Sequoia, Teton, White Rose, and No. 47258. This

TABLE 1.—*Number of weeks required by 35 different varieties of potatoes to sprout when stored at 70°, 60°, 50° and 40° F. during three storage seasons*

Variety	1945-1946				1946-1947				1947-1948				Approximate Varietal Average			
	70°	60°	50°	40°	70°	60°	50°	40°	70°	60°	50°	40°	70°	60°	50°	40°
Calrose	—	—	—	—	5	7	9	25	5	7	9	23	5	7	9	24
Cayuga	—	—	—	—	7	7	11	28	7	7	9	23	7	7	10	25
Chippewa	7	7	11	27	7	7	11	43	9	9	13	38	8	8	12	36+[1]
Earlaine	7	7	11	23	7	9	11	28	9	9	11	27	8	8	11	26
Earlaine 2	5	7	11	23	5	7	9	26	7	7	9	25	6	7	10	25
Erie	5	7	15	35	5	7	11	43+	7	7	13	38+	6	7	13	39+
Golden	5	5	7	11	5	5	7	9	—	—	—	—	5	5	7	10
Green Mountain	7	9	17	33	7	9	11	30	11	11	17	35	8	10	15	33
Houma	7	7	15	27	7	7	11	28	9	9	9	27	8	8	12	27
Irish Cobbler	7	9	15	27	9	9	11	26	9	9	13	38	8	9	13	30
Kasota	7	7	11	25	7	7	11	24	9	9	11	25	8	8	11	25
Katahdin	7	9	17	43	7	7	11	30	9	9	11	38+	8	8	13	40+
Kennebec	—	—	—	—	—	—	—	—	9	9	19	38+	9	9	19	38+
Menominee	7	7	13	27	5	5	11	26	7	7	11	38	6	6	12	30
Mesaba	7	9	11	25	7	9	11	28	7	7	11	33	7	8	11	29
Mohawk	9	11	17	29	9	9	11	27	9	9	13	25	9	10	14	27
Norkota	5	7	11	25	7	7	11	26	9	9	9	33	7	8	10	28
Pawnee	7	7	13	23	7	9	11	28	7	7	11	27	7	8	12	26
Pontiac	7	9	17	23	7	9	20	43+	9	9	17	38+	8	9	18	35+

TABLE 1. (Cont'd.)—*Number of weeks required by 35 different varieties of potatoes to sprout when stored at 70°, 60°, 50° and 40°F. during three storage seasons.*

Variety	1945-1946				1946-1947				1947-1948				Approximate Varietal Average			
	70°	60°	50°	40°	70°	60°	50°	40°	70°	60°	50°	40°	70°	60°	50°	40°
Potomac	11	13	43+	43+[1]	7	9	43+	43+	9	9	38+	38+	9	10	41+	41+
Red Warba	7	9	17	31	7	7	11	32	7	7	9	25	7	8	12	29
Russet Burbank	7	9	17	27	7	9	11	28	9	11	13	27	8	10	13	27
Russet Rural	9	9	15	25	9	9	11	26	9	9	11	25	9	9	12	25
Rural New Yorker	9	9	13	25	9	9	11	26	9	9	11	25	9	9	12	25
Sebago	5	7	11	43+	5	5	11	43+	7	7	11	38+	6	6	11	41+
Sequoia	7	9	15	33	7	7	13	39	9	9	17	38+	8	8	15	37+
Teton	7	9	23	43+	9	9	20	43+	7	7	17	38+	8	8	20	41+
Triumph	7	9	13	35	9	9	9	32	9	9	11	38	8	9	11	35
Warba	7	7	15	33	7	7	11	28	7	7	11	25	7	7	12	29
White Rose	7	13	17	25	7	7	11	28	11	17	17	27	8	12	15	27
24642	5	7	11	25	7	7	11	35	7	7	11	33	6	7	11	31
46952	7	7	11	25	7	7	11	35	7	7	11	25	7	7	11	28
47258	7	7	23	43+	7	7	20	43+	7	9	25	38+	7	8	23	41+
B61-3	—	—	—	—	—	—	—	—	7	9	9	25	—	—	—	—
B69-16	—	—	—	—	—	—	—	—	7	9	38+	38+	—	—	—	—
Approximate average of all varieties for each temperature.													7	8	14	31+

[1]+ indicates that no sprouting was visible at termination of this particular storage test.

does not mean that most of the varieties that do not fall in this class and are classed as "short-keepers" cannot be used longer than 14 weeks. The values shown in the table simply indicate when sprouting began. After the initiation of sprouting the growth was usually relatively slow and the tubers were still usable for such processing as chipping, French frying, or dehydrating for four to six weeks thereafter, since the rate of sprout growth varied from only a trace to about one-sixteenth to one-eighth of an inch the first month after initiation at this temperature. At 40° the sprout growth as late as the last of June usually amounted at most to only a trace and was entirely lacking in many varieties.

The above facts are presented to show that, while there are wide varietal differences, the usable life of potato stocks at 50°F. is much longer than is commonly realized. Since potatoes held at this temperature are usually suitable for immediate use by processers without further conditioning, much time and expense in handling commercial stocks could be saved by manufacturers and those who supply hotels and restaurants. With the use of sprout inhibitors early in the storage period according to directions given by the manufacturers, the usable life of potato stocks at this temperature can be lengthened. Furthermore it is desired to emphasize to potato breeders that long-dormancy is an important factor to consider in any breeding program.

YAMPA, A NEW SCAB-RESISTANT POTATO

L. A. SCHAAL AND W. C. EDMUNDSON[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Washington, D. C.

AND

R. KUNKEL[3]

Colorado Agricultural Experiment Station, Fort Collins, Colo.

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ORIGIN

When the program of breeding potato varieties resistant to scab was begun, little was known regarding the existence of physiological races of the scab organism. Experiments with the physiological races

[1]Pathologist.
[2]Senior Horticulturist.
[3]Horticulturist.

of the scab fungus have shown that although many races are present in a given soil, a variety of potato resistant to one race is usually resistant to all. A few exceptions have been noted (1).

The development of potato varieties possessing desirable horticultural characters and having disease resistance and good quality has been difficult. The absence of scab-resistant, early-maturing parent material has added to the difficulty. Most scab-resistant seedlings have been late maturing. Several German varieties were shown to be highly resistant to scab. Two of these, Hindenberg and Richter's Jubel, were crossed with superior commercial varieties. Many new scab-resistant seedlings were produced and tested in uniform scab test plots conducted by the U. S. Department of Agriculture and cooperating State Agricultural Experiment Stations. Several seedlings were found to be resistant to scab in all places tested. All were late-maturing but possessed other characters that are desirable. Several of these have been named: Menominee in Michigan, by Wheeler, Stevenson, and Moore (3); Ontario, Seneca, and Cayuga in New York, by Blodgett and Stevenson (1).

From a limited number of the more promising scab-resistant seedlings, several were selected as parent material and used in crosses made at the U. S. Potato Station at Greeley, Colorado. A cross, U.S.D.A. Seedling 245-186 X Katahdin, produced a large number of desirable seedling varieties which were tested in scab plots located in most of the potato-growing areas of the United States. Several selections from this cross showed high scab resistance and other desirable characteristics. One of these selections, C.S. 6317, which has been named Yampa[a], was found to be as high yielding as standard varieties, scab resistant, of good shape on lighter soils, and to have good cooking quality.

Description

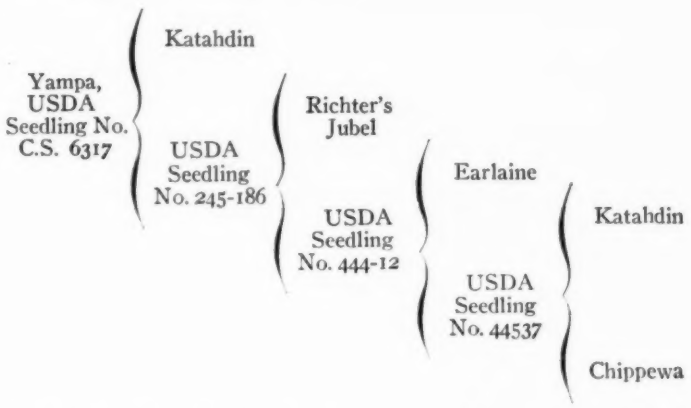
Plants, medium in size, erect; stems thick, prominently angled; nodes slightly swollen, green; internodes green; wings slightly waved, green; stipules small, in lowest peduncle, clasping. Leaves medium in length, broad, open type, light bluish-green; mean length of blade 57.71 + 0.35 mm. (2.27 inches)[a]; mean width 38.88 + 0.26 mm. (1.53 inches); index 66.93 + 36.[b] Midribs green, scantily pubescent; pri-

[a]An Indian name meaning "Little Bear," also the name of a mountain valley in northwestern Colorado where this variety was tested and increased.

[a]Calculations after method of Salaman, R. N. Potato Varieties. 378 pp. illus. Cambridge. 1926.

[b]Calculated by dividing the width of each of 100 leaflets by their length, and multiplying the average of these ratios by 100.

The pedigree of Yampa follows:



mary leaflets medium in number, in two positions—on midrib between pairs of primary leaflets and at junction of midrib and petioles; tertiary leaflets few. Inflorescence little branched; leafy bracts none; peduncles medium in length to short, green scantily pubescent; pedicles short, little pigmented, abundantly pubescent.

Flowers: Calyx lobes long to medium in length, little pigmented, abundantly pubescent; corolla small (diameter 1 inch), white; anthers orange yellow shading to lemon yellow; pollen scant; style straight; stigma bilobed, green.

Tubers roundish, thick, mean length 85.21 + 0.39 mm. (3.35 inches)[c]; mean width 76.07 ± 0.43 mm. (2.99 inches); mean thickness 59.57 + 0.32 mm. (2.34 inches); mean indices: width to length 89.49 + 0.76; thickness to width 78.49 + 0.50; thickness to length 70.08 + 0.58. Skin slightly flaked in some soils, smooth in others, self-colored, varying from cream to buff, variation depending on type of soil; flesh white; eyes shallow, same color as skin; eyebrows not prominent, curved. Sprouts in diffuse light, light perilla, purple at base of sprout; body of old sprout highly colored; tip of leaf scales reddish; base of lateral leaf scales colored. Maturity medium early.

Characteristics

Yampa is a medium early variety, maturing about 7 to 10 days after Bliss Triumph when grown under the same conditions.

The tubers are round to blocky, with shallow eyes and vary in color from white to light russet depending on the soil. They are classed as white in the commercial trade. Fig. 1 shows a Yampa tuber.

[c]Measurements based on 100 tuber sample of 8 oz. tubers.

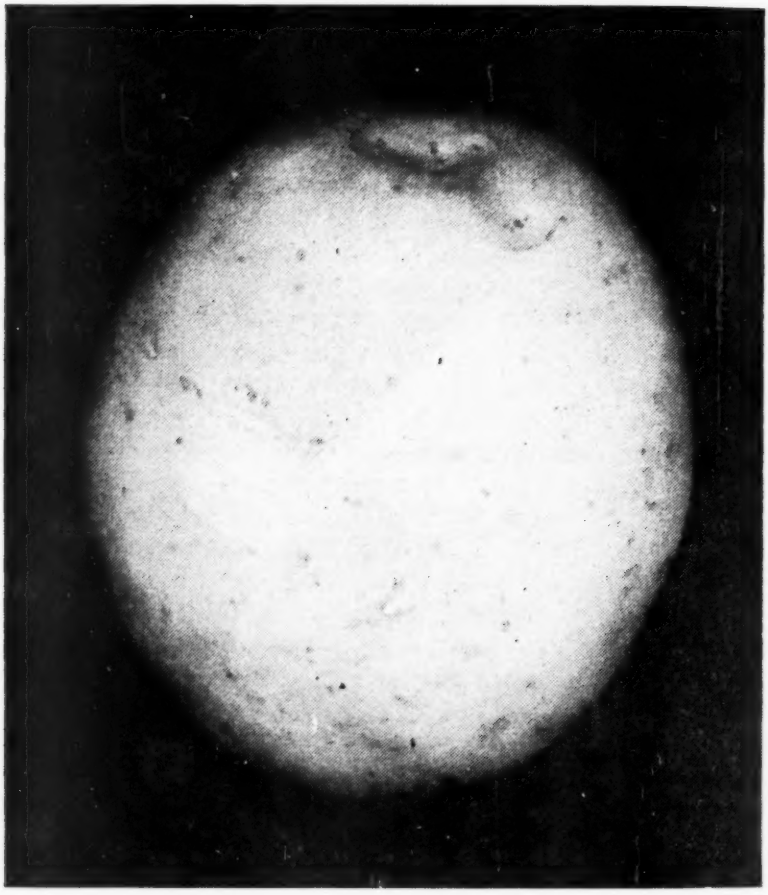


FIG. 1 YAMPA TUBER

This variety has been grown in test plots located in practically all of the major potato-growing states. It was resistant to scab in all but two of these tests. More recent tests have shown Yampa to be infected with No. 4 type pustules in one area in Colorado and one in California. Observations and greenhouse tests indicate that there is a degree of resistance to leaf roll and mild mosaic. This variety appears to be somewhat resistant to tuber infection from late blight, but light infection of the leaves and stems has been noted. It is resistant to early blight, having only small lesions on the leaves; in no test has defoliation occurred as in the case of more susceptible varieties.

The cooking quality of Yampa is above average. The keeping quality is good under average conditions. In sandy soils the tuber skin has a tendency to become slightly russeted. The skin is firm and tubers do not show skinning injury or cracking at harvest. When grown in soils with high fertility it has a tendency to oversize, if spaced too far apart in the row; and in heavy soils considerable growth cracks develop. It sets deeper than Katahdin and therefore does not sunburn as readily.

Adaptation and Comparison

Most tests have been conducted in Colorado, where it has been grown in several of the scabby areas as a late crop and has produced good yields of marketable tubers in most places. When grown as an early variety in the scabby soils of Colorado, high yields of practically scab-free tubers have been produced. Table 1 shows the total yield, yield of U.S. No. 1 tubers, mean total yield, and per cent of culls due to scab in a field heavily infested with scab, at Gilcrest, Colorado, for the years 1945-1948 inclusive.

Bliss Triumph did not produce any No. 1 tubers in 2 of the 4 years of testing in this scab-infested soil. Most of the Bliss Triumph crop was marketed as U.S. No. 2 tubers because of scab in this plot. In 1945, 43.1 per cent were graded as culls because of scab, and in 1946, 37.6 per cent. Yampa did not significantly outyield Bliss Triumph in 1945, 1946, or 1948, but produced a higher percentage of U.S. No. 1 tubers than did Bliss Triumph. Table 2 shows the total yields of Yampa, other varieties, and several seedling varieties in 1946 at 7 places in Colorado, one in Wyoming, and one in Iowa. In all cases Yampa equaled or out-yielded the other varieties tested.

Table 3 indicates that the differences in total yield between Katahdin, C. S. 6317, Pawnee, Red McClure, C. S. 3175, Irish Cobbler, and Bliss Triumph were not great enough to be statistically significant at the 5 per cent level.

Table 3 also indicates that the difference in per cent (by weight) of U.S. No. 1 tubers over two inches in diameter was not great enough to be significant at the 5 per cent level between Katahdin, Pawnee, and Irish Cobbler. Yampa, 6316, Red McClure, 3175, Russet Burbank, and Bliss Triumph all gave a significant decrease in grade.

There was no significant difference in specific gravity.

Dissemination

The United States Department of Agriculture has no seed of the Yampa variety for general distribution. Certified seed growers in Colorado are increasing the seed stocks of this variety.

TABLE 1.—*Yield of Yampa and Bliss Triumph at Gilcrest, Colorado.* 1945, 1946, 1947, *and* 1948.

Variety	1945			1946			1947			1948			
	Total Yield Bus.per Acre	Per Cent U.S. No. 1 Tubers	Per Cent Culls Due to Scab	Total Yield Bus.per Acre	Per Cent U.S. No. 1 Tubers	Per Cent Culls Due to Scab	Total Yield Bus.per Acre	Per Cent U.S. No. 1 Tubers	Per Cent Culls Due to Scab	Total Yield Bus.per Acre	Per Cent U.S. No. 1 Tubers	Per Cent Culls Due to Scab	Mean Total Yield 4 Years
Yampa	708.2	92.8	0.0	642.7	95.4	0.0	828.6	97.	0.0	879.0	97.0	0.0	764.6
Bliss Triumph	679.3	0.0	43.1	584.6	0.0	37.6	751.1	60.	20.0	850.0	90.0	5.0	716.2
M.S.D. 5% level	91.0			62.0			74.3			68.9			

TABLE 2.—*Total yield in bushels per acre of Yampa and other varieties and seedling selections, at 7 places in Colorado, 1 in Wyoming, and 1 in Iowa,* 1946.

Variety or Seedling	Gilcrest, Colorado	WoodyCreek Colorado	Windsor, Colorado	Montrose, Colorado	Yampa, Colorado	La Porte, Colorado	Greeley, Colorado	Laramie, Wyoming	Crystal Lake Iowa
Yampa	642.7	408.5	286.5	423.0	598.2	372.6	365.9	307.2	459.0
C.S. 6316	551.7		203.2	293.3	384.4	319.4	346.6	255.5	428.0
C.S. 6332		414.3	245.8						
C.S. 6362			255.6	339.7	294.2				
C.S. 6344	627.2	375.6		343.6		325.2			
Bliss Triumph	584.6*							283.2*	
Pawnee			269.1*		484.0*		405.5*		
Irish Cobbler						265.5*			295.0*
Rural New Yorker				421.0*					
C.S. 3175	653.3	305.8	224.5	265.2	540.1	316.5	392.0		
Russet Burbank	62.2	319.4*							
M.S.D. 5% level		69.6	27.3	52.0	59.3	66.8	65.9	35.9	50.0

*COMMERCIAL VARIETY OF THAT LOCATION AT TIME OF TEST.

TABLE 3.—*A comparison between several potato varieties and seedlings at Fort Collins in* 1948.

Variety	Total Yield Bus. per Acre	Per cent U.S. No. 1's above 2 in. in Diameter	Specific Gravity
Katahdin	409	80.7	1.090
Yampa (C.S. 6317)	433	69.1	1.093
Pawnee	396	86.2	1.091
C. S. 6316	304	68.9	1.09
Red McClure	371	71.9	1.098
Russet Burbank	325	53.1	1.093
C. S. 3175	387	71.6	1.087
Irish Cobbler	413	79.7	1.084
Bliss Triumph	443	70.8	1.102
M.S.D. 5 per cent level	76	10.9	NS
M.S.D. 1 per cent level	102	8.1	

SUMMARY

The Yampa potato has shown considerable promise as a scab-resistant, good-quality, high-yielding variety. It has shown field resistance to scab, early blight, and to leaf roll and mosaic. It appears best adapted to the lighter mineral soils. It has a relatively tough skin and keeps well. Maturity is approximately 7 to 10 days later than Irish Cobbler or Bliss Triumph.

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SECTIONAL NOTES

Indiana

We are harvesting some of the best Katahdins, Chippewas, and Cobblers that we have ever harvested in the state. Our crop is clean, the size is good, and the potatoes are moving in large quantities almost as fast as they are being harvested. We are also enjoying good harvesting weather as it is not too hot, and the soil is fairly dry. Our yields are running from 400 to 600 bushels of No. 1's per acre, which is very good, and no one is complaining about the price. W. B. Ward.

Kentucky

Harvesting begun on the 11th of July, and is now complete, except for small lots over scattered areas. Ninety per cent were Irish Cobblers, with some Sequoia and a trace of Sebago. Although the latter two are specifically late varieties, test lots have behaved so well in the past few seasons that have been unusually wet, that growers have begun venturing to plant them as first crop, because of their fine appearance.

The early part of our season was rather wet, but just as settings-on started, came a drought of 26 days that affected Irish Cobbler (which is usually early enough to escape), and also reduced the acreage of Sequoia and Sebago drastically. The Irish Cobbler variety averaged 125-150 marketable bushels per acre, as against the usual 200 bushels—a great percentage of under-size tubers occurring. The quality was superior, however, and all No. 1 Cobblers moved well without assistance, only the "B-size" of the three varieties needed to be moved under the Marketing Act.—John S. Gardner.

Maine

Aroostook has had an excellent growing season. The drought which hit New England did not affect the county, and the excellent seed with plenty of fertilizer and little late blight indicates a yield of 400 bushels per acre which is the highest on record. Very few cases of late blight are apparent in the county. Aphids are present but in very small numbers as DDT has been used by all farmers regularly. Where aphids were numerous, Parathion has given excellent control.

In general, digging is expected to start about the 19th of September. Already farmers are starting to kill the tops with roto-beaters and sprays.

PMA records indicate that more than 99 per cent of all Maine growers stayed within their potato allotments this year.

Two potato meetings of particular interest to growers were the

Potato Blossom Festival, with Ralph Trigg, President of the Commodity Credit Corporation as speaker, and the Farm Bureau Field Day with Dr. Roger Corbett as speaker.

The Maine Experiment Station has recently issued three bulletins which are very timely and carry much helpful information; namely, Bulletin No. 470 by Drs. G. W. Simpson and W. A. Shands, entitled, "Progress on Some Important Insect and Disease Problems of Irish Potato Production in Maine; Bulletin 471 by Drs. Bonde and Schultz, entitled, "Control of Late Blight Tuber Rot;" and Bulletin No. 472 by William Schrumpf, entitled, "Practices, Costs, and Tuber Bruising in Digging Potatoes in Aroostook County, Maine."—VERNE C. BEVERLY.

NEBRASKA

The reports on the Nebraska potato crop have been scarce as the proverbial hen's teeth, because of the rush of other work. After things quieted down from the great blizzard of 1949, potato production has been on a very safe and sane basis.

The early crop of central and eastern Nebraska, on which harvesting has just been completed, was somewhat below the yields of the past seasons. In the Gibbon-Kearney district, yields were below those of a year ago, because of the extreme heat. In the area around Cozad, yields equalled those of the previous year, and in some cases exceeded 400 bushels per acre of very high quality. The central and eastern areas produce practically all the Red Warba variety, with just a few acres of Irish Cobblers still in the picture. A few varieties are being tried, with mediocre success, generally because of their lateness.

In the western part of the state, which is the late main crop, a number of troubles were encountered at planting time in June. Excellent conditions obtained at the beginning of the month, but a satisfactory period of a week to ten days followed on the 10th of June, which resulted in poor stands in many fields. At the beginning of the planting season, the entomologists reported excessive build-up of the psyllid insects, and warned growers to be on the alert to dust or spray potatoes immediately after emergence. This admonition was followed by a great many growers, however, a few doubting Thomases did nothing until psyllid damage appeared in their fields. This has proven to be one of the most serious outbreaks of psyllid damage since the trouble was recognized in this area. The last year comparable to this one was 1938. In most cases early patches of potatoes and tomatoes that were untreated, were a total loss.

Even though the summer has been above the average in tempera-

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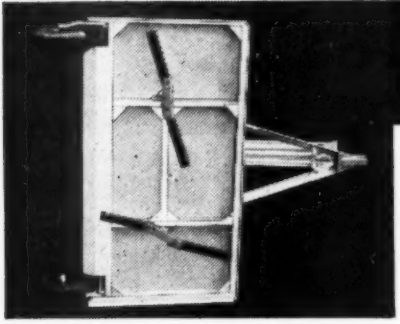

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tures, the growth of the potatoes in fields, on both irrigated and dry land, is progressing satisfactorily. There have been occasional rains in the dry land areas, to carry the fields, but those fields are at a critical point now, and a general rain is needed to get good production on the dry land. Two serious hail storms have struck the western area of Nebraska, therefore the production of all crops in those sections will be materially reduced. Some crops, particularly beans, will be a total loss, and potatoes may be reduced as much as 75 per cent. Our irrigated acreage is progressing satisfactorily, barring an early blight epidemic.

The acreage entered for certification in Nebraska has dropped about 8 per cent compared with last year. This is the fourth consecutive year that a reduction in acreage has taken place in this territory. The variety "Progress," released to the industry a year ago, is being increased substantially, both under certification and in commercial acreage. Therefore, Nebraska is comparable to other states in introducing new varieties in production.—MARX KOEHNKE.

NEW YORK

Because of an occasional shower during the past month the outlook for the certified seed crop in New York State has improved to a great extent. It now looks as if we may get a fair yield. However, the size of the tubers may tend to be rather uneven. Aphid counts have been low and little blight has been found.

The second inspection is proceeding according to schedule and should be completed in approximately ten days.—F. JOHN MACABEE, (*Inspector*).

The Crop

On the 5th of September we had a larger percentage than usual of green vines although we have had the hottest and driest summer in years. The set is light, especially in some sections, and the size is smaller than usual in many areas for this time of season. However, with green vines there is a possibility that material increases could be expected if rain and cooler weather come. In some areas the crop is good.

Varieties

This has been a good season to test new varieties for the resistance to heat and dry weather. Both Essex and Ontario have shown up well in this respect and give promise of crops considerably ahead of some of our standard varieties.

Seed

Second inspections have not yet been completed but there are in-

dications that the percentage certified will be higher than last year. The acreage was somewhat reduced. Yields will no doubt be reduced. To summarize, it looks as though our certified seed will be a little lighter than last year on the whole, and the size and quality much better because of weather conditions. Both insects and plant diseases have been kept under control.

Marketing Agreements

No definite steps have been taken but the committee is trying to find out if certain variations can be made to fit the Metropolitan conditions. There is considerable interest among potato growers and shippers. Nothing has been submitted in the way of a written agreement.

Prices

The few early potatoes that are now appearing on the markets are meeting with very good receptance and bringing a little more money than out-of-state potatoes. There are not enough being sold to establish a market, but apparently freshly dug up-state potatoes look better to the buyers than some of the more wilted potatoes reaching us from the southern areas.

Meetings

The next big meeting on the calendar is the Annual Meeting of the Empire State Potato Club held in connection with the New York State Vegetable Growers and the Weed Control people in New York, from January 3rd to 6th inclusive, at the Hotel New Yorker. Invitations are being sent to neighboring states and it is hoped that these meetings will be very well attended. The program committee is trying to work out a program that will be of interest to the whole area rather than to the state alone.

The Summer Field Meeting of the Potato Club was very well attended. The official count of cars was well over 9000.—H. J. Evans.

OREGON

As of this date the 17th of August, we have finished our first field inspection, with 900 acres of Russets and 450 acres of White Rose passing this inspection. The general quality seems excellent although the amount entered for certification is greatly reduced as compared with 1948. Potatoes are recovering rapidly from the effects of the severe frost on the 29th of June. This recovery has become particularly pronounced since the first of August but the yields will be very low throughout this district unless a long unfavorable growing season occurs.—C. A. Henderson.

Vermont

The total acreage of potatoes in Vermont is estimated by the Bureau of Agricultural Economics at 6400—an all time low since records were kept. There are, however, more large scale professional growers than ever before with fields between the 50 and 125-acre level. These growers are well equipped with up-to-date machinery and storehouses.

Stands in these commercial fields are good this year and there has been comparatively little virus or other disease. Late blight has been reported in only a few instances. The prolonged hot, dry weather has, however, unquestionably reduced yield. A small set has been reported in many cases, and tuber growth can scarcely catch up at present. Many fields as of the 1st of September were showing signs of ripening off.

About 660 acres were entered for certification and the percentage of rejection thus far is low. About 500 acres are evenly divided between Katahdins and Green Mountains, with Houmas making up most of the remainder.

Of the newer varieties a few fields of Tetons have apparently produced very satisfactorily.—Harold L. Bailey.

Dominion of Canada

The acreage entered for field inspection in 1949 amounted to 71,321 acres compared with 70,561 in 1948.

This is an increase of 760 acres above the final figures entered in 1948. However, there has been a decrease in all provinces except New Brunswick, Quebec, Saskatchewan and Alberta. The increase in New Brunswick amounted to approximately 3,000 acres, consisting mainly of Katahdins. There has been an increase in Katahdins, Chippewa and Sebago planted in Prince Edward Island with a corresponding decrease in Green Mountain and Irish Cobbler.

The leading varieties in Canada are Katahdin, Green Mountain, Irish Cobbler, Sebago, Netted Gem, Bliss Triumph, White Rose and Pontiac.

In general, the potato crop throughout Canada has suffered to some extent through lack of moisture, although it is a little early to determine whether any extensive damage has been done or not.

Seed Potato Certification Inspectors from coast to coast report that the crop is remarkably free from disease. Insects have done little damage where a systematic DDT spray or dust program has been used at frequent intervals.—J. W. Scannell.

Province of Prince Edward Island

The month of August was very dry until the 19th, at which time we had a downpour of rain which averaged three inches. Our crop is now doing very well. We have had a few traces of late blight but have kept it well in check this year.

Mr. S. G. Peppin, Chief of the Inspection Services, completed his final field inspection on the 3rd of September. He reports that there is a high percentage of Foundation and Foundation A seed in this year's crop. At the present time, indications are pointing toward fair to good yields and for the second year in succession no bacterial ring-rot has been reported. It is expected that our seed will be ready for shipment by the 15th of October.—E. D. Reid

THE POTATO ASSOCIATION OF AMERICA

An Historical Note

E. V. Hardenburg

Cornell University, Ithaca, N. Y.

To be at all permanent, an organization should serve some useful purpose. In fact most societies originate from a need for some important functions to be performed. The Potato Association of America was organized more than 30 years ago and its record of useful accomplishment would seem to justify the ambitions of those who conceived it.

Certain phases of the potato industry began to assume national scope about the time of World War I when our food supply was a matter of concern. Federal grade standards were promulgated under the leadership of Herbert Hoover in 1917 when he was United States food administrator. The production of certified seed potatoes was begun in Wisconsin in 1914 followed by New York in 1915. Such matters as grade standards and the development of seed certification standards were of nationwide interest. There developed a need to provide a clearing house organization to coordinate such matters to the mutual advantage of all potato states. A publication in which the results of current potato research could be made available to all was needed. Varietal nomenclature was in need of clarification and the breeding of better varieties was demanded by growers. Out of this situation, came the Potato Association of America and its official publication.

Now that our organization has completed 25 years of publication, it is fitting that we here make note of the results. Beginning in November 1923, two numbers of Volume I were published that year under the

name, The Potato News Bulletin. Volumes II and III were published under the same title in 1924 and 1925, respectively. The name of the official publication was changed to American Potato Journal in 1926. Since then Volume 25, No. 12, December 1948 has been completed. Altogether 8910 pages have been printed in the 25 volumes. The writer had occasion recently to peruse an index of articles published in these first 25 volumes. Following is a classification of the 976 articles into subject matter headings.

Classification of Articles in First 25 Volumes of the American Potato Journal

Subject Matter	No. of Articles	Per cent of Total	Subject Matter	No. of Articles	Per cent of Total
Diseases and Insects	319	32.7	Costs	8	0.8
Seed	118	12.1	Plot Technique	7	0.7
Fertilizer	106	10.9	Weed Control	7	0.7
Internal Quality	59	6.1	Record Yields	6	0.6
Industry	56	5.7	Irrigation	6	0.6
Breeding	55	5.6	Vine Killing	5	0.5
Varieties	50	5.1	Sprout Inhibitors	4	0.4
Marketing	41	4.2	Wheel Injury	3	0.3
Anatomy and Botany	30	3.1	Harvesting	3	0.3
Storage	24	2.5	Grading	2	0.2
External Quality	14	1.4	Weather	2	0.2
Culture	14	1.4	Hollowheart	2	0.2
Planting	11	1.1	Machinery	1	0.1
Rotation	11	1.1	Livestock Feed	1	0.1
Soil	10	1.0	Sprout Tuber	1	0.1

Total number of articles written—976.

It is noteworthy that nearly one-third of the published articles concerned potato diseases and insects and their control. Other phases of the industry in order of their rank in published material were seed, fertilization, internal quality, industry problems, breeding and varieties. Rank in number of published articles may stand as an indication of the research interest and production problems characteristic of this quarter century of potato production in America.

Great credit is due Doctor William H. Martin and his coworker Dr. Elizabeth Clark for splendid work. Under the Editorship of Dr. Martin, the American Potato Journal has earned a place of respect among the scientific journals now published in America. This is to extend the thanks of the membership to him, to congratulate the Association on its good fortune and to present the hope that the next 25 years will be as satisfying.